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Harp seals and seal invasions: what we know and what we believe

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SUMMARY

In the course of winter and spring 1987, between 60 and 100,000 harp seals drowned, caught in fishing gear on the Norwegian coast. Causes of the so-called invasion have been vehemently debated, for instance in the mass media. The debate has often been characterized by poor knowledge. Much of the harp seals' biology is well known, but other things are poorly known. The latter specially include stock sizes, migrations and feeding. These are important factors when it comes to explaining the seal invasion. This article gives an overview of harp seal biology and the seals' recent and earlier invasions along the Norwegian coast. Last year the seals must have come from both West Ice and White Sea stocks. It is reasonable to assume that the capelin in the Barents Sea has been a principal food item for harp seals in this region in parts of the year. A collapse of capelin stocks must thereby have led to the seals seeking alternative food. Increased activity with change in migration patterns will lead to a need for increased food quantity, absence of which will lead to hunger. It is reasonable to suppose that this is one of the chief causes for last year's seal invasion on the Norwegian coast.

Seal systematics

We have seven species of seals in Norwegian waters, but only two of these are tightly bound to the Norwegian coast: grey and harbour seals. The five others: ringed, harp, bearded, and hooded seals, and walrus, are tied to arctic regions and are only more or less chance visitors to mainland Norwegian coasts.

Systematically, walrus belong with sea lions and fur seals, but the other seals in Norwegian waters belong to the "true" or "earless" seals.

People have long believed that seals developmentally form a single group (Pinnipedia) closely related to the terrestrial carnivores. In the last 10-15 years it has, however, become more and more acknowledged that seals have developed in two lines from the terrestrial carnivores. The "false" seals, including walrus, developed from bear-like animals, while the true seals developed from the martens. This will have taken place more than twenty million years ago.

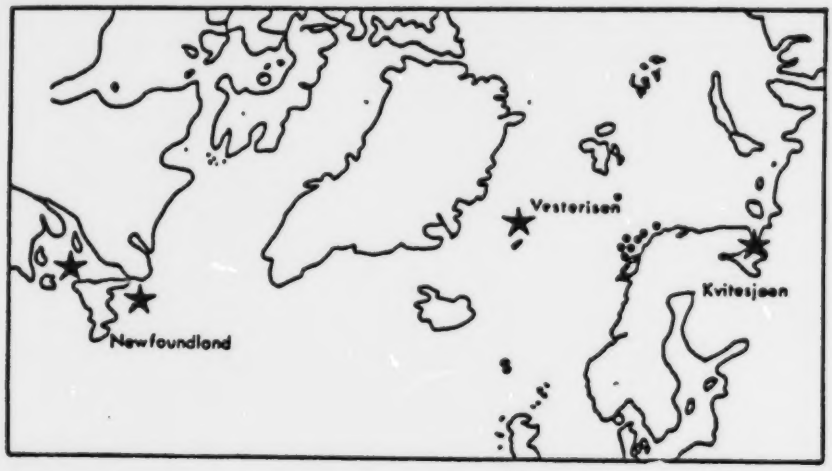
Harp seal biology

There has at times been a great deal of confusion over which seal species is being talked about in the seal invasion debate, both by the man on the street, the press, and even in parliament. In several places, the traditional coastal seal stocks of grey and harbour seals have gotten the blame for the "seal plague", but it is in reality harp seals which have invaded the Norwegian coast in recent years.

The harp seal is a medium to large seal. Adult animals are between 1.5 and 2 m. long and weigh from 100 to 150 kg. The male is a little larger than the female, but sexual differences are not so great as we find in other seal species such as the grey and hooded seals.

Distribution

Harp seals are found in three more or less distinct stocks in the northern Atlantic Ocean, with quite separate whelping patches (welping - give birth)(Fig. 1)



Figur 1. Grønlandsselens kasteområder (stjerne) samt gjenfangster på norskekysten av grønlandsse merket i Vesterisen (ø) og i Kvitesjøen (o).

Fig. 1 Harp seal whelping patches (stars) and recaptures on the Norwegian coast of harp seals marked in the West Ice(.) and the White Sea(o).

Figur 2. Grønlandssel (brunsel) med nyfødt unge.

Fig. 2 Harp seal (bedlamer pelage) with newborn young.

There is a stock in the western Atlantic which gives birth in the Gulf of St. Lawrence and off the coast of Newfoundland. There is a stock which, broadly speaking, lives in the region between Greenland and Svalbard and gives birth north of Jan Mayen (West Ice). The third stock lives in the Barents Sea and gives birth in the White Sea. There is supposed to be relatively little exchange between the three stocks. Analyses of cranial and body dimensions have shown that the West Atlantic stock is separated more from the other two than they are from each other. As is evident in another article in this issue of Naturen, chemical analyses show a clear difference between seals from the West Ice and from the White Sea.

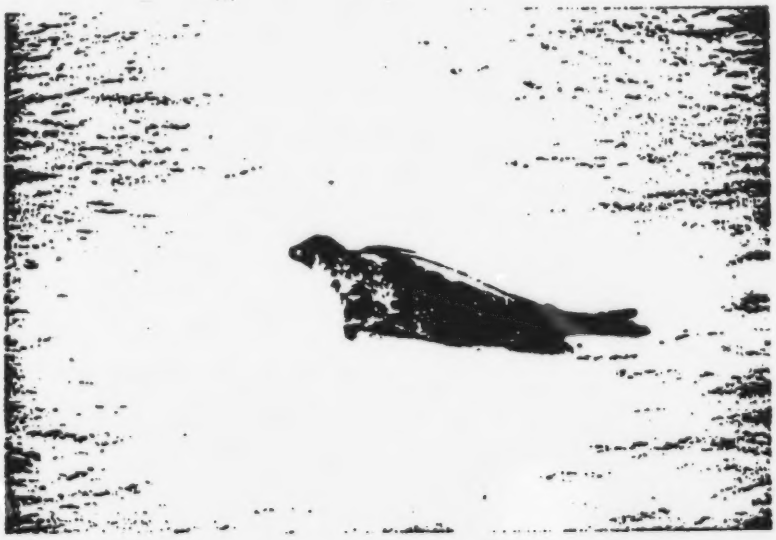
Reproduction

Harp seals collect in large whelping patches (patch = assembly) in the aforementioned regions in February - March to give birth on the ice. The young are born with a yellow-white lanugo (juvenile pelage) and weigh about 12 kg. at birth (Fig. 2). The lanugo, which gets whiter after some days, (whitecoat, see Frontispiece) falls off after 2-4 weeks and a grey pelt with a dark upper side replaces it.

After the mother has left the young, she mates. The fertilized egg divides a few times, but remains lying free in the uterus for ca. 100 days before it attaches itself to the uterine wall and develops further to be born next spring. This gives a pregnancy of ca. 50 weeks.

The female gives birth to its first young when 5-6 years of age and can give birth nearly every year until it is over 30 years old. The male can also become mature at 5-6 years, but doesn't take part in pairing before it is somewhat older.

Ca. 4 weeks after pairing, the seals lie up in big moulting patches to change the hair coat. The harp seal keeps the pattern of its young seal pelt for 6-8 yrs. i.e. it is grey with larger or smaller spots (bedlamer, Fig. 2). Thereafter, the characteristic saddle on the back and the black head develop over some years (saddle seal, old harp, Fig. 3)



Figur 3. Sadelsel.

Fig. 3 Old harp

Migration

After moulting, the seals follow the ice border north on feeding migrations. One has long supposed that in summer the West Ice seals nourished themselves in the Greenland Sea, and the White Sea seals in the northern Barents Sea.

When the ice has formed up again in autumn, the seals migrate south. This is a migration pattern which one finds again in actual captured animals. However, there is much to suggest that the migration pattern varies with age and sex.

Feeding

The harp seal's feeding habits are rather poorly known. This is first and foremost due to the fact that the seals practically don't feed during reproduction and moult, when the traditional seal catching takes place.

In general, the harp seal can be considered an opportunistic feeder, i.e. it eats what is most easily available. The best known studies of the harp seal's food habits were carried out in Canada. According to these studies, the young begin to feed on Crustacea after the moult, while fish such as capelin, herring and polar cod become important food items for older animals. That Crustacea are an important food for seals in the White Sea was apparent from Sivertsen's records from the East Ice (Barents Sea) in the 1930's. The principal stomach contents of seals studied were Crustacea and polar cod. Harp seals studied in the Varangerfjord in winter 1984 had stomachs filled with capelin, capelin roe and a little cod, while studies of seals further south along the coast in 1986 and 1987 showed a wide spectrum of fish species with herring, saithe and [oyepal] together with Crustacea and squid.

During a voyage to the region between Svalbard and Franz Josef Land in August 1987, the Sea Fishery Institute collected stomach samples from harp seals at the ice edge. The majority (55%) of animals here had caught a 1.5

cm. long Amphipod Crustacean Parathemisto libellula. There were also fish species like polar cod, sea scorpion and Greenland halibut together with other Crustacea and squid in the stomach. These studies also indicate that harp seals find part of their food on the bottom to at least 300 m. in depth.

However, the studies give a biased picture of harp seal feeding, and reflect for the most part what was accessible to seals in the place where they were caught.

At the Biological Institute, University of Oslo, there has been developed a special simulation model of harp seal food requirements. This model shows that the young harp seal must eat the equivalent of 22% of its body weight per day for normal growth, while an adult harp seal can get by with a food intake corresponding to 5% of body weight per day.

If we use a stock of 1 million harp seals in the Barents Sea which grows at 6% per annum as a base, this stock will have an annual requirement for 1.8-3.8 million tonnes of food, depending on the food's energy content (Fig. 4, Table 1).

Table 1. Energy content of some harp seal food items, in kcal/gm.

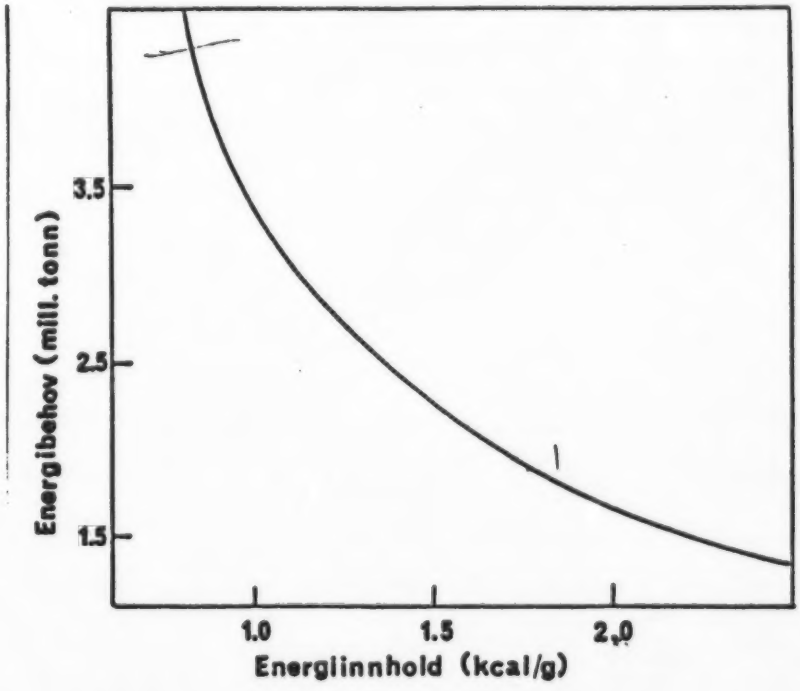
Item	kcal/gm
Capelin	1.5-2.4
Herring	2.0-2.4
Cod	1.0
Polar Cod	1.0
Crustacea	1.0

Stock Size

White Sea.

From the Norwegian side a stock estimate was carried out in the White Sea in 1978 which showed a stock of ca. 800,000 animals and production of 168,000 young. A projection of this on the basis of a yearly growth of 5% gives an estimate of 1.2 million animals in 1987.

From the Soviet side in the last two years have come research results which suggest that the relative recruitment to the stock of harp seals in the White Sea has been reduced. This is based on aerial surveys of whelping females and that the mean age of these has increased, It has also been stated that the stock of whelping females went down 40% from 1986 to 1987 but this is not documented.



Figur 4. Årlig matbehov for en bestand på 1 mill. grønlandssel ved forskjellig gjennomsnittlig energiinnhold i maten.

Fig 4. Annual food needs of a stock of 1 million harp seals, with different mean energy content of food.

West Ice.

There is no up-to-date estimate of the stock size of the harp seals which give birth in the West Ice. Quite preliminary and unsure analyses done this year based on caught and marked animals lead to a production of ca. 40,000 young in 1980. This leads to a stock estimate of ca. 200,000 animals. From the relatively low catch of the last few years one must suppose that this stock has been growing subsequently.

West Atlantic Stock.

Canadian estimates give the stock of harp seals in the west Atlantic as 1.5 to 2.0 million in 1985.

This gives a total stock of ca. 3 million harp seals in the North Atlantic Ocean.

Seal Invasions on the Norwegian Coast

1987

In the course of the winter of 1987 there was a mass migration of harp seals to the Norwegian Coast. The first seals were caught in fishing gear on the coast of West Finmark and Troms before Christmas. All through January, harp seals were observed along the whole Norwegian coast down to the Skagerak. On the 15 of January, we could even see a harp seal on an icefloe at BMV-Lakesvaag only a few hundred m. from the Sea Fisheries Institute.

The seals' influence on fish along the coast was great. It seemed as if the seals scared the fish away from the fishing grounds, and some boats got more seals than fish in their nets. Shortage of fish and lost employment caused the fishermen great economic loss.

To compensate for this loss, an indemnity was paid out of 400 Kr. per seal brought on board. In this way we also got a measure of how many seals were taken on different parts of the coast.

By the beginning of February, ca. 14,000 seals had been caught in fishing gear. This increased to 35,000 in mid March and totalled between 50,000 and 60,000 by the end of May along the whole coast from Finmark to the Skagerak. Most were nevertheless taken in Troms and Lofoten (Table 2), mainly in nets, but also on lines and trawls.

The seals brought to land were mainly young harp seals (1 to 2 years old) but older animals and saddled seals also occurred. The seals which were brought to land do not give a complete picture of those drowned in fishing gear. Many animals fell out of the gear before and during hauling. It is natural to believe that this was the case to a greater degree for the older and heavier animals than for the younger and lighter ones.

Table 2. Regional breakdown of harp seal caught in fishing gear on the Norwegian coast in winter 1987 up to 15 March.

Region	Number
East Finmark	649
West Finmark	4,004
Troms	11,535
Nordland-Vesteraalen	2,272
Nordland N. With Lofoten	9,571
Nordland S.	2,313
N. Trondelag	1,178
S. Trondelag	1,815
N. More	871
Sunmore and Romsdal	1,055
Sogn and Fjordane	586
Hordaland	415
Rogaland	85
Skagerak Coast	240

It is impossible to indicate exactly how many seals occurred along the Norwegian coast in the winter of 1986-87. If we consider the long stretch of coast the animals found themselves on, and that in spite of everything, fishing gear did not line the whole way, I consider a death rate of 25% as reasonable. If we also accept that the total number of dead seals lay between 60,000 and 100,000, the total number becomes 300,000 to 400,000 seals. At this point it must be mentioned that not all the animals registered were harp seals. There was also an element of ringed seals, hooded seals and the traditional coast species of harbour and grey seals.

In the Varanger region, there were relatively few harp seals in the first three months of the year but it appeared that many seals came in to the coast in early April. In the course of a short time, ca. 6,000 were taken

in nets off Vardo. The fish in this region soon came to an end, and the seals seem to have vanished.

Even though the bulk of the harp seals seem to have vanished at the beginning of June, we have information which shows that there were still harp seals on the Norwegian coast in summer and autumn 1987. In November, it was reported with great fanfare that large numbers of seals were on their way in to the Finmark coast. These proved to be unfounded rumours. Right around Christmas, there was reported a netted catch of harp seals both in Varangerfjord and in (the) Tana (estuary). This was however regarded as normal by the local fishermen. The occurrence of harp seals on the Norwegian coast is thus no new phenomenon.

Earlier Seal Invasions

At the Zoological Museum in Bergen, there can be found much bone material from archaeological digs which shows that there were harp seals on the Norwegian coast many thousand years ago. But it was a time with quite different climatic conditions from now.

The literature from the time around the turn of the last century documents that harp seals came from the east and invaded the eastern part of Finmark in certain years. They came in April and disappeared northward in June. It looks as if these seals came to the coast in a period of cold climate in the Barents Sea. The seals were locally called "Spring seal" or Russian seal".

1902 and 1903 were specially cold in the Barents Sea and the ice lay over large regions. In these two years there were enormous numbers of harp seals

on the coast. In both years the harp seals came into the coast at New Year. These seals were known as "winter seals" and had occurred on the Muran coast almost every winter since 1890. They were also known as "Spitsbergen seal" because they seemed to come from the north.

In addition to the "winter seals", the "spring seals" came to the coast in April 1902. Most of the seals were described as young animals and sexually mature males, with few sexually mature females.

In the summer of 1902, harp seals were seen on the coast in many regions, including South Norway, so it was clear that they over-summered on the coast. That was not normal.

Then, in November 1902, masses of seals came into the coast of Nordland, seemingly from the northwest. They were chiefly young harp seals. They wandered far south, and in the course of the winter and spring, harp seals were taken in the Skagerak. The number invading the coast was not known but it must have been very great. It is recorded that in 1903, 4,000 harp seals were caught in fishing gear in Porsanger. In the same way as in 1987, the fish disappeared so that the fishing was very poor.

Such a mass migration of harp seals on the Norwegian coast did not occur between 1903 and 1987. A smaller number of seals occurred in certain years, for example in the period 1978 to 1984. The general course of events in this last period was that the seals came in to the coast of East Finmark from the sea or Murmansk coast from late December to the beginning of

February. It is thus the same pattern as we found with "winter seals" at the turn of the century.

Later, in March-April, there came a new wave of seals. Young of the year were also observed in May. This agrees well with what we earlier named "spring seal". In 1985 there were some harp seals in East Finmark, which was also the case in 1986.

In 1986 the harp seals came into the coast at West Finmark, Troms and Nordland. The first were in fact caught in a net between Sorya and Senja as early as November-December 1985. These animals appeared to wander south and some were caught on the Trondelaq coast in April 1986. We also have information which points to there having been some harp seals on the Skagerak coast and occasionally even on the Swedish west coast in the course of spring and summer 1986.

The total compensation paid out in 1986 was for 4,500 harp seals.

Condition

Many of the seals which were studied were very thin. Collections from South Norway showed a fat thickness of around 15 mm, while one found fat thicknesses of between 10 and 50 mm at Lofoten. In 1986 the fat thickness lay between 10 and 45 mm (mean 25 mm) for animals caught in Troms.

With this background, and the fact that the capelin stock in the Barents Sea has been completely overexploited, it has been asserted that the harp seals in the Barents Sea last year were driven to the Norwegian coast by hunger.

It's timely to mention here that the harp seals caught in the traditional seal catch in the West Ice and the East Ice outside the White Sea in 1987 were apparently in normal condition. It is therefore important to be clear that it was chiefly young seals which were analysed on the Norwegian coast, while the catches at West and East Ice were chiefly of old animals, and that some of the limited studies of harp seal food items suggest that food composition varies with age.

In arctic waters it is a general pattern that organisms in the sea move northward in summer and southward in winter. In the Barents Sea we also find that in years with low temperatures in the sea, the fish stocks are found further west than in years with high temperatures. The periods 1900 to 1903, 1977 to 1982, and 1985 to 1987 were cold years in the Barents Sea. These are factors which support the idea that occurrence of "winter seals" and "spring seals" in East Finmark can be connected with climate in the sea.

The harp seal on the Norwegian coast can come from two stocks, that in the Barents Sea or in the Greenland Sea, or from both. It is supposed that harp seals in East Finmark have come from the eastern stock because of the short distance from the whelping region, and observations of seals migrating along the Murman coast.

We also know that there have been three occasions when harp seals came to the coast further west and south than the traditional "winter" and "spring" seals. This happened in the years 1902/03, 1985/86 and 1986/87.

In the period 1977 to 1987, 6,258 harp seals were marked in the West Ice. Returns of these animals, outside the West Ice, came from East Greenland, North Iceland, and North Norway. Most recaptured animals outside the whelping area have been young animals. The nine caught on the Norwegian coast were taken from December to May. Six of them were taken in West Finmark and Lofoten in 1986 and 1987.

Table 3. Marking of harp seals in the West Ice and recaptures on the Norwegian coast.

Marking Year	Number Marked	Recaptures										
		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1977	479	-	2	-	-	-	-	-	-	-	-	-
1978	487	-	-	-	-	-	-	-	-	-	-	-
1983	1 304	-	-	-	-	-	-	-	1	-	-	-
1984	1 333	-	-	-	-	-	-	-	-	-	-	-
1985	611	-	-	-	-	-	-	-	-	-	2	3
1987	2074	-	-	-	-	-	-	-	-	-	-	1

These recaptures, plus the view that the chief body of seals came into the coast further south in 1985/86 and 1986/87 than in preceding years which was also noticed in autumn 1902, have led to the acceptance of the idea that the invading animals in these years have, partly at least, had an origin other than the years before, that is to say that West Ice animals in these years have been more important than in years before. This was also the opinion in 1902/03.

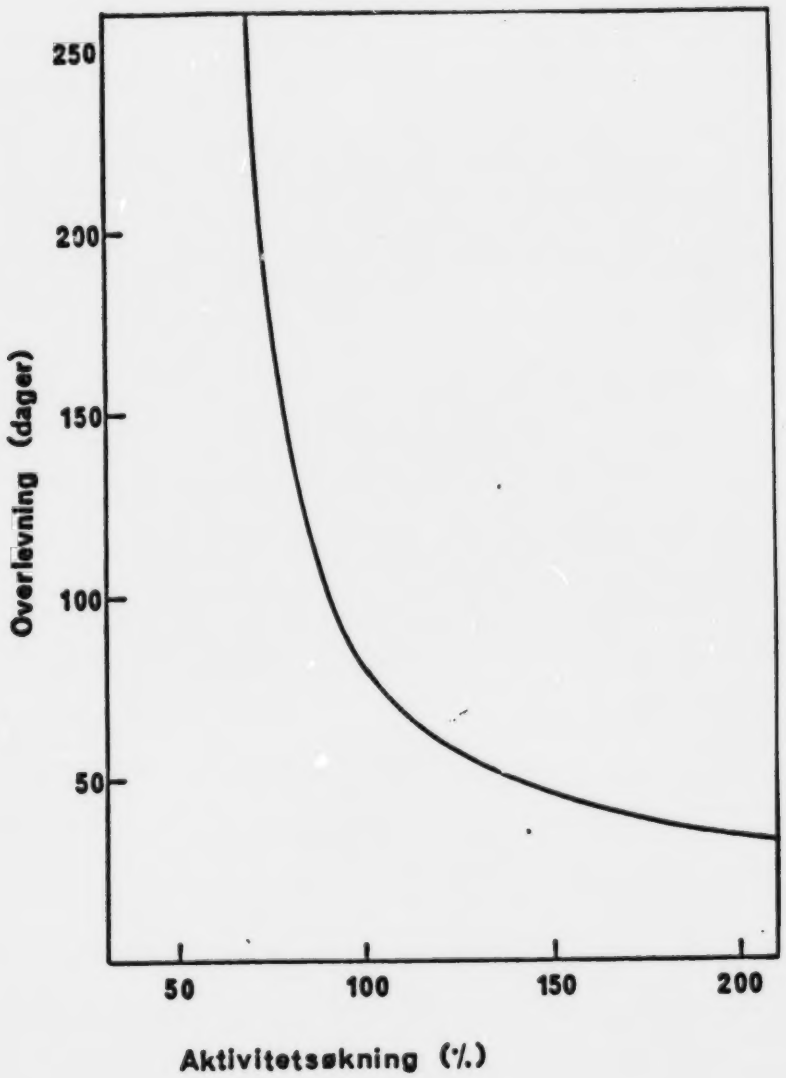
As mentioned above, we have limited knowledge of stock size in the West Ice, but we believe it is growing. Catch statistics for the period 1974-1983 show a cut at about 10,000 animals each year, while only 1,700 were taken in the cut in the period 1984 to 1986. It is claimed, therefore, that there could be a relation between the low catch of young harp seals in this region and the seal invasion on the Norwegian coast in 1986 and 1987. It can also be noted that catch statistics from the turn of the the century show that each year ca. 20,000 harp seals were taken, but in 1901 only 7,000. If however, we compare the suggested stock size in the West Ice of 200,000 with the large number of seals which have come to the Norwegian coast last year, little doubt remains that the animals must have come from both stocks.

In order to clarify the evidence as to what degree harp seals from the White Sea stock are found on the Norwegian coast, the Sea Fisheries Research Institute, in 1986, began a cooperative study with Soviet seal researchers on marking young seals at the whelping patches in the White Sea. In 1986 therefore, we sent 500 marks to the Russians. These were used in 1987 and a ca. four months old harp seal was caught at Arendal in July 1987.

As is shown in another article in this issue of Naturen, one has been able to show with chemical analyses of fatty acids that seven harp seals caught at Sunmore in February 1987 came from the White Sea stock.

The harp seals on the Norwegian coast in winter 1985/86 and 1986/87 bore the stamp of undernourishment. The harp seal is a social animal which hunts in larger or smaller herds. The large concentrations of food-rich capelin wich were earlier found in the Barents Sea can be supposed to have constituted an optimal food resource for such a lifestyle. Even though we lack more exact knowledge we think it natural to suppose that capelin have truly been important food items in the Barents Sea for part of the year. Following this assumption, one must suppose that the collapse of the capelin stock in the Barents Sea has had a significance for seals as for other capelin predators. Cod, for example, changed its food organisms between 1985 and 1986. This the harp seal must also have had to do. Important species here seem to be first and foremost polar cod and different Crustacea. This demands quite certainly a complete change in migration patterns.

In a project on the harp seal's food needs at the Biological Institute, University of Oslo, supported by the Fishery Directorate, an assessment is being made of the consequences of an uncontrolled population growth of harp seals. In a food-short situation it seems that the seals will use more time in swimming in a hunt for food, and try to occupy new regions. Energy use will then increase proportionally with activity increase. If the seals can't get increased access to food, they will be in a state of hunger which can lead to death (Fig. 5). For me the past year's seal invasion resembles this picture.



Figur 5. Overlevingstid for grønlandssel ved økt aktivitet og begrenset næringstilgang.

Fig. 5 Survival time of a harp seal with increased activity and limited access to food. Vertical axis - survival in days; horizontal axis - increase in activity %.

Translated from Norwegian to English by D. E. Sergeant, Department of Fisheries and Oceans, Arctic Biological Station, Ste-Anne-de-Bellevue, Québec.